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Proposed Re-evaluation Decision

Diazinon

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Foreword

Proposed Re-evaluation Decision for Diazinon

Health Canada's Pest Management Regulatory Agency (PMRA) has finalized the risk and value assessments for the active ingredient diazinon and its end-uses on food and non-food areas.

On 30 June 2005, Re-evaluation Note REV2005-06, *Preliminary Risk and Value Assessments of Diazinon,* was published for consultation. As a result, additional information was received regarding environment and value. The PMRA has completed its review of stakeholders comments on the preliminary risk and value assessments and, under the authority of the *Pest Control Products Act*, is proposing continued registration of some diazinon uses and a measured phase-out of other diazinon uses of products for sale and use in Canada (see Appendix IV). An evaluation of available scientific information found that:

- under the proposed conditions of use, certain uses of diazinon products have value in the food and crop industry and do not involve a level of concern to human health or the environment. These uses are application by ear tag on cattle and application of emulsifiable concentrate and wettable powder products by groundboom soil drench on blackberry, broccoli, Brussels sprouts, cabbage, cauliflower, loganberry, onion, raspberry, rutabaga and turnip. As a condition of the continued registration for these uses, new risk-reduction measures must be included on the labels of certain diazinon products. In addition, registrants must submit additional scientific information;

- the remaining uses of diazinon are proposed for phase-out as registrants do not support continued registration or because of the human health risks and/or risks to the environment. These diazinon uses include air blast application on Christmas tree plantations; uses on greenhouse pepper and tomatoes, mushroom houses and tobacco seedling; all uses of granular formulation on food crops; seed treatments for beans (including soybean), corn, onion, peas, potato, radish and sugar beet; and all foliar sprays on food and feed crops and outdoor ornamentals.

Two general time frames are proposed for the phase-out of the above uses. Some uses will be phased out as soon as practical, whereas the information currently available to the PMRA indicates longer time-frames are needed for other uses, allowing for a measured phase-out and/or strategies to transition from the use of diazinon to alternative control methods. These longer time frames are proposed for some application methods to Christmas tree plantation, greenhouse tobacco seedlings, apple, blackberry, carrot, cherry, cranberry, currant, gooseberry, loganberry, onion, parsnip, radish, raspberry, rutabaga, strawberry and turnip. The PMRA is proposing that these uses be permitted until the end of 2012 to allow for transition to alternative pest

management tools. In the interim, measures to mitigate risk to workers and the environment will be implemented for these crops. The PMRA will accept written comments on the proposed phase-out of the uses of diazinon and will also consult with stakeholders to identify transition needs.

The PMRA's pesticide re-evaluation program considers potential risks as well as the value of pesticide products to ensure they meet modern standards established to protect human health and the environment. In 1999, Health Canada announced in Re-evaluation Note REV99-01, *Re-evaluation of Organophosphate Pesticides*, that 27 organophosphate active ingredients, including diazinon, would be re-evaluated in Canada.

This proposal affects all end-use products containing diazinon registered in Canada. Once the final re-evaluation decision is made, registrants will be instructed on how to address mitigation measures and data requirements.

This Proposed Re-evaluation Decision is a consultation document[1] that summarizes the science evaluation for diazinon and presents the reasons for the proposed re-evaluation decision. It also proposes additional risk-reduction measures to further protect human health and the environment.

The information is presented in two parts. The Overview describes the regulatory process and key points of the evaluation, while the Science Evaluation provides detailed technical information on the human health, environmental and value assessment of diazinon.

The PMRA will accept written comments on this proposal up to 60 days from the date of publication of this document. Please forward all comments to Publications (please see contact information on the cover page of this document).

[1] "Consultation statement" as required by subsection 28(2) of the *Pest Control Products Act*

Table of Contents

Overview 1
Proposed Re-evaluation Decision for Diazinon 1
What Does Health Canada Consider When Making a Re-evaluation Decision? 2
What Is Diazinon? 3
Health Considerations 3
Environmental Considerations 6
Value Considerations 7
Measures to Minimize Risk 8
What Additional Scientific Information Is Being Requested? 9
Next Steps 9
Other Information 10

Science Evaluation 11

1.0 Introduction 11

2.0 The Technical Grade Active Ingredient, Its Properties and Uses 11
2.1 Identity of the Technical Grade Active Ingredient 11
2.2 Physical and Chemical Properties of the Technical Grade Active Ingredient . . . 12
2.3 Description of Registered Diazinon Uses 12

3.0 Impact on Human and Animal Health 13
3.1 Toxicological Summary 13
3.2 Occupational, Residential, Dietary and Aggregate Exposure and Risk 13

4.0 Impact on the Environment 13
4.1 Fate and Behaviour in the Environment 13
4.2 Effects on Non-target Species 13
4.2.1 Effects on Terrestrial Organisms 14
4.2.2 Effects on Aquatic Organisms 17

5.0 Value 18
5.1 Value of Diazinon 18
5.1.1 Diazinon Uses (in addition to those identified in REV2005-06) for Which Comments on Value were Received 18
5.1.2 Diazinon Uses for which Comments were Received Indicating that Registered Alternatives are Available, or Diazinon is Rarely Used 21
5.1.3 Diazinon Uses for Which no Comments were Received 21

6.0 Toxic Substances Management Policy Considerations 22

7.0 Summary 22
7.1 Human Health and Safety 22
7.2 Environmental Risk 22
7.3 Value 23

8.0 Proposed Regulatory Decision 24
8.1 Proposed Regulatory Actions 25
8.1.1 Proposed Regulatory Action Related to Human Health 25
8.1.2 Proposed Regulatory Action Related to Environment 28
8.2 Additional Data Requirements 28
8.2.1 Data Requirements Related to Toxicology 28
8.2.2 Data Requirements Related to Occupational Exposure Assessment 28
8.2.3 Data Requirements Related to Food Residue Chemistry 28
8.2.4 Data Requirements Related to Value 29

List of Abbreviations 31

Appendix I Registered Diazinon Products as of 11 December 2006[a] 33

Appendix IIa Registered Commercial Class Uses of Diazinon Supported by the Technical Registrants as of December 2006 35

Appendix IIb Registered Commercial Class Uses of Diazinon Supported by the Technical Registrants as of December 2006 39

Appendix III Summary of crop-pest combinations for which the stakeholders provided comments on the value of diazinon, in addition to those identified in REV2005-06. Registered alternatives as of December 2006 are provided. 41

Appendix IV Proposed diazinon phase out criteria by use site and application method based upon value considerations and availability of registered alternative active ingredients 49

Overview

Proposed Re-evaluation Decision for Diazinon

After a re-evaluation of the insecticide diazinon, Health Canada's Pest Management Regulatory Agency (PMRA), under the authority of the *Pest Control Products Act* and Regulations, is proposing continued registration of some diazinon uses and a measured phase-out of other diazinon uses of products for sale and use in Canada (see Appendix IV). An evaluation of available scientific information found that:

- under the proposed conditions of use, certain uses of diazinon products have value in the food and crop industry and do not involve a level of concern to human health or the environment. These uses are application by ear tag on cattle; and application of emulsifiable concentrate and wettable powder products by groundboom soil drench on blackberry, broccoli, Brussels sprouts, cabbage, cauliflower, loganberry, onion, raspberry, rutabaga, turnip. As a condition of the continued registration for these uses, new risk-reduction measures must be included on the labels of certain diazinon products. In addition, registrants must submit additional scientific information.

- the remaining uses of diazinon are proposed for phase-out as registrants do not support continued registration or because of the human health risks and/or risks to the environment. These diazinon uses include air blast application on Christmas tree plantations; uses on greenhouse pepper and tomatoes, mushroom houses and tobacco seedling; all uses of granular formulation on food crops; seed treatments for beans (including soybean), corn, onion, peas, potato, radish and sugar beet; and all foliar sprays on food and feed crops and outdoor ornamentals.

  Two general time frames are proposed for the phase-out of the above uses. Some uses will be phased out as soon as practical, whereas the information currently available to the PMRA indicates longer time-frames are needed for other uses, allowing for a measured phase-out and/or strategies to transition from the use of diazinon to alternative control methods. These longer time frames are proposed for some application methods to Christmas tree plantation, greenhouse tobacco seedlings, apple, blackberry, carrot, cherry, cranberry, currant, gooseberry, loganberry, onion, parsnip, radish, raspberry, rutabaga, strawberry and turnip. The PMRA is proposing that these uses be permitted until the end of 2012 to allow for transition to alternative pest management tools. In the interim, measures to mitigate risk to workers and the environment will be implemented for these crops. The PMRA will accept written comments on the proposed phase-out of the uses of diazinon and will also consult with stakeholders to identify transition needs.

The PMRA's pesticide re-evaluation program considers potential risks as well as the value of pesticide products to ensure they meet modern standards established to protect human health and the environment. In 1999, Health Canada announced in Re-evaluation Note REV99-01, *Re-evaluation of Organophosphate Pesticides*, that 27 organophosphate active ingredients, including diazinon, would be re-evaluated in Canada. Re-evaluation draws on data from registrants, published scientific reports, information from other regulatory agencies and any other relevant information available.

What Does Health Canada Consider When Making a Re-evaluation Decision?

The key objective of the *Pest Control Products Act* is to prevent unacceptable risks to people and the environment from the use of pest control products. Health or environmental risk is considered acceptable if there is reasonable certainty that no harm to human health, future generations or the environment will result from use or exposure to the product under its conditions or proposed conditions of registration[2]. The Act also requires that products have value[3] when used according to label directions. Conditions of registration may include special precautionary measures on the product label to further reduce risk.

To reach its decisions, the PMRA applies rigorous, modern hazard and risk assessment methods and policies. These methods consider the unique characteristics of sensitive subpopulations in both humans (e.g. children) and organisms in the environment (e.g. those most sensitive to environmental contaminants). These methods and policies also consider the nature of the effects observed and the uncertainties present when predicting the impact of pesticides. For more information on how the PMRA regulates pesticides, the assessment process and risk-reduction programs, please visit the PMRA's website at www.pmra-arla.gc.ca.

Before making a re-evaluation decision on diazinon, the PMRA will consider all comments received from the stakeholders in response to this consultation document[4]. The PMRA will then publish a Re-evaluation Decision document[5] on diazinon, which will include the decision, the reasons for it, a summary of comments received on the proposed registration decision and the PMRA's response to these comments.

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2 "Acceptable risks" as defined by subsection 2(2) of the *Pest Control Products Act*

3 "Value" as defined by subsection 2(1) of the *Pest Control Products Act*: "the product's actual or potential contribution to pest management, taking into account its conditions or proposed conditions of registration, and includes the product's (a) efficacy; (b) effect on host organisms in connection with which it is intended to be used; and (c) health, safety and environmental benefits and social and economic impact".

4 "Consultation statement" as required by subsection 28(2) of the *Pest Control Products Act*

5 "Decision statement" as required by subsection 28(5) of the *Pest Control Products Act*

For more details on the information presented in this overview, please refer to the Science Evaluation section of this consultation document and Re-evaluation Note REV2005-06, *Preliminary Risk and Value Assessments of Diazinon*. REV2005-06, published on 30 June 2005, provided a summary of preliminary assessments based on the review of data and information available at that time. The information received in response to REV2005-06 was reviewed and used to refine the risk and value assessments as well as to propose regulatory action. REV2005-06 can be found at:

English	www.pmra-arla.gc.ca/english/pdf/rev/rev2005-06-e.pdf	or
French	www.pmra-arla.gc.ca/francais/pdf/rev/rev2005-06-f.pdf.	

What Is Diazinon?

Diazinon is an organophosphate insecticide used to control a broad range of insect pests on a wide variety of greenhouse food crops, terrestrial feed crops, terrestrial food crops, outdoor ornamental and nursery crops, livestock, non-crop land and on seeds as a protective seed treatment. It is applied using air blast, hydraulic sprayers (boom, backpack and hand wand sprayers), granular applicators, paint brushes (in mushroom houses), seed treatment equipment and as slow release ear tags for cattle. Application methods that were not assessed, as they were not supported by the registrants, include fogging in greenhouses and aerial application.

Background on the initial assessment of diazinon, including a summary of the uses, can be found in Re-evaluation Note REV2005-06, *Preliminary Risk and Value Assessments of Diazinon*.

Health Considerations

Can Approved Uses of Diazinon Affect Human Health?

The assessment of human health aspects was discussed in REV2005-06. Additional risk reduction measures are required on diazinon labels.

Exposure to diazinon may occur through diet (food and water), when handling treated nursery plants, working as a mixer/loader/handler or by entering treated sites. When assessing health risks, two key factors are considered: the levels where no health effects occur, and the levels to which people may be exposed. The dose levels used to assess risks are established to protect the most sensitive human population (e.g. children and nursing mothers). Only those uses where exposure is well below levels that cause no effects in animal testing are considered acceptable for continued registration. Toxicology studies in laboratory animals describe potential health effects from varying levels of exposure to a chemical and identify the dose where no effects are observed.

Diazinon is of slight to moderate acute toxicity via oral exposure and of low acute toxicity via the dermal and inhalation routes of exposure. Diazinon is mildly irritating to the skin and minimally irritating to the eye and is considered a skin sensitizer.

An overexposure to diazinon inhibits the enzyme acetylcholinesterase, interrupting the transmission of nerve impulses. It works by contact, ingestion and vapour action. Symptoms such as tremors, salivation, and shortness of breath may occur after diazinon exposure in animals and humans. Diazinon is rapidly absorbed and excreted and does not accumulate in tissues. Accordingly, exposure to diazinon in adult animals produced neurobehavioural symptoms soon after exposure. However, there were no significant structural changes to the brain, spinal cord, or peripheral nerve after any exposure.

Toxic effects on development and reproduction were observed in animals but only at very high doses that were also toxic to the mother, indicating that there is no additional sensitivity of the young. Diazinon given to pregnant animals did not result in any structural developmental changes to the fetus. Diazinon was not genotoxic and did not cause cancer in animals. The risk assessment is conducted to ensure that the level of human exposure is well below the lowest dose at which effects occurred in animal tests.

Residues in Food and Water

Dietary risks from food and water are not of concern.

Reference doses define levels to which an individual can be exposed over a single day (acute) or lifetime (chronic) and expect no adverse health effects. Generally, dietary exposure from food and water is acceptable if it is less than 100% of the acute reference dose or chronic reference dose (acceptable daily intake). An acceptable daily intake is an estimate of the level of daily exposure to a pesticide residue that, over a lifetime, is believed to have no significant harmful effects.

Human exposure to diazinon, including that of the most highly exposed subpopulation (e.g. children 1 to 6 years old), was estimated from residues in treated food commodities. This dietary exposure represents less than 76% of the acute reference dose and less than 31% of the chronic reference dose. Based on the available surveillance data, exposure that may occur from drinking water is not of concern. However, additional confirmatory data may be required.

The *Food and Drugs Act* prohibits the sale of adulterated food, that is, food containing a pesticide residue that exceeds the established maximum residue limit (MRL). Pesticide MRLs are established for *Food and Drugs Act* purposes through the evaluation of scientific data under the *Pest Control Products Act*. Each MRL value defines the maximum concentration in parts per million (ppm) of a pesticide allowed in/on certain foods. Food containing a pesticide residue that does not exceed the established MRL does not pose an unacceptable health risk.

MRLs for diazinon are currently specified for apples, apricots, beans, beets, broccoli, Brussels sprouts, cabbage, cantaloupes, carrots, cauliflower, celery, cherries, citrus fruits, collards, cranberries, cucumbers, endives, figs, grapes, hops, kale, kohlrabi, lettuce, Lima beans, muskmelons, onions, parsley, parsnips, peaches/nectarines, pears, peppers, plums, radishes, salsify, spinach, strawberries, summer squash, Swiss chard, tomatoes, turnip tops, turnips, wasabi, watermelons, winter squash or processed foods derived from these foods. Where no specific MRL has been established, a default MRL of 0.1 ppm applies, which means that pesticide residues in a food commodity must not exceed 0.1 ppm. The proposed MRL amendments for diazinon can be found in the Science Evaluation section of this consultation document.

Risks in Residential and Other Non-Occupational Environments

Potential risks to homeowners while using diazinon or from contact with commercially treated plants were mitigated through a voluntary phase-out of domestic class products and residential uses in 2000. Diazinon can no longer be used in and around homes or other residential areas such as parks, school grounds, playing fields.

Occupational Risks From Handling Diazinon

Occupational risks are of concern for workers performing high exposure activities during application.

Based on both the precautions and directions for use on the current product labels, and also considering the maximum use of protective equipment and measures, the risk estimates associated with applying, mixing and loading activities did not meet current standards for several use scenarios and are of concern. The scenarios of concern include seed treatment, airblast, some hand held equipment, and indoor applications for mushroom and tobacco crops. Other use scenarios such as ear tags for cattle and application by groundboom for most crops are not of concern. See Appendix II of REV2005-06 for additional information.

Postapplication risks are of concern to workers performing high exposure activities.

Postapplication occupational risk assessments consider exposures to workers re-entering treated sites in agriculture. Based on the precautions and directions for use on the current product labels, postapplication non-cancer risks to re-entry workers performing high-exposure activities, such as thinning, pruning and harvesting of most crops, did not meet current standards and are of concern.

Proposed protective measures to reduce worker exposure require consultation with user groups to determine their acceptability to the agricultural community. These measures, in addition to protective equipment, include revised restricted-entry intervals (REIs) and restricting the number of diazinon applications that can be made.

Environmental Considerations

What Happens When Diazinon Is Introduced Into the Environment?

Further to an earlier assessment (REV2005-06), a more refined assessment has confirmed that diazinon poses a potential risk to pollinators, birds, small wild mammals, aquatic invertebrates, amphibians and fish.

Diazinon released into the environment can be found in soil, surface water, air and rain. Diazinon will volatilize from moist surfaces and water. Diazinon is slightly persistent in soils and non-persistent in aquatic systems. Diazinon has a moderate potential for mobility in a variety of soil types. Available Canadian monitoring data indicate that diazinon is readily reaching surface water. Field studies indicate that diazinon did not leach below 30 cm of soil depth. Oxypyrimidine was identified as the primary transformation product and was observed to leach to a depth of 180 cm, which may be a concern for groundwater contamination.

Foliar applications of diazinon are a concern for pollinators, birds and small herbivorous wild mammals feeding on the site of application, as well as some sizes and food guilds of birds and small herbivorous wild mammals feeding in terrestrial habitats adjacent to the site of some applications. Foliar applications of diazinon are also a concern for aquatic invertebrates, amphibians, and fish from residues in spray drift and based on Canadian surface water monitoring data which is a compilation of all sources of exposure including spray drift and runoff.

Granular applications of diazinon are a high risk for small birds and wild mammals since the consumption of very few granules (5 granules for a small bird) is required to reach the dose causing 50% mortality in the test population (LD_{50}). Field studies conducted in the United States have demonstrated that granular applications of diazinon can adversely affect birds and small wild mammals in the treatment area.

Seed treatments also pose a high risk to small birds since the number of treated seeds that need to be consumed in order to reach the LD_{50} is very small (1 to 20 seeds).

Value Considerations

What Is the Value of Diazinon?

The value of diazinon was discussed in REV2005-06, *Preliminary Risk and Value Assessments of Diazinon* and stakeholder comments were requested.

In response to REV2005-06, stakeholders indicated additional uses to those identified in REV2005-06 were considered of value, as follows:

- apple to control woolly apple aphid;
- beet to control aphids;
- blackberry to control leafhoppers;
- carrot to control aphids;
- cherry to control black cherry aphid, cherry fruit fly and mealybugs;
- cole crops (broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi) to control aphids, diamondback moth and imported cabbageworm;
- cranberry to control cranberry fruitworm, blackheaded fireworm and Sparganothis fruitworm;
- currant/gooseberry to control aphids, lecanium scale and sawflies;
- lettuce to control dipterous (fly) leafminers;
- onion to control onion maggot and thrips;
- parsley to control diamondback moth and imported cabbageworm;
- parsnip to control aphids, dipterous leafminers and flea beetles;
- pepper to control aphids;
- radish to control dipterous leafminers and flea beetles;
- raspberry to control aphids, leafhoppers and thrips;
- rutabaga/turnip to control aphids, dipterous leafminers, flea beetles and adult root maggots;
- tobacco seedlings in greenhouses to control ants; and
- tomato to control aphids.

Comments in response to REV2005-06 indicated phase-out of diazinon would likely have little impact on the following uses:

- lettuce to control aphids;
- radish to control aphids; and
- spinach to control aphids and leafminers.

No comments were received in response to the request for information on value and use in REV2005-06 for the following crops:

- mushroom houses;
- Christmas tree plantations;
- outdoor ornamentals (commercial production);
- stone fruits (apricot, peach);
- pear;
- bean;
- leafy vegetables (collard, Swiss chard);
- cucurbits (cucumber, melon, squash);
- grape; and
- hops.

Measures to Minimize Risk

Labels of registered pesticide products include specific instructions for use. Directions include risk-reduction measures to protect human and environmental health. These directions must be followed by law. As a result of the re-evaluation of diazinon, the PMRA is proposing further risk-reduction measures for product labels.

Additional Risk-Reduction Measures

Human Health

- The proposed phase-out of certain uses (outlined in Appendix IV) will reduce worker risk. During the phase-out period and for any on-going uses, additional personal protective equipment (PPE), implementation of closed mix/loading systems are proposed to mitigate worker risk. Post-application risks are addressed by restricted entry intervals.

Environment

- The risk to birds and small wild mammals from granular applications, seed treatments and all foliar applications cannot be mitigated. Therefore, the PMRA proposes to phase out these application methods.
- The environmental risks are determined to be acceptable for ear tag use on cattle and soil drench applications on blackberry, loganberry, raspberry, onion, rutabaga, turnip and cole crops (broccoli, cabbage, brussels sprouts, cauliflower). Appropriate environmental precautionary statements will be specified on the label.

What Additional Scientific Information Is Being Requested?

The human health risks and/or risks to the environment for certain uses of diazinon were found to be acceptable, and additional confirmatory scientific information is being requested from registrants as a result of this re-evaluation.

Human Health

- Diazinon is a neurotoxicant in adult animals, with acetylcholinesterase inhibition as the most sensitive endpoint of concern. The toxicology database lacks a developmental neurotoxicity study, which is required in order to refine the toxicology risk assessment. The developmental neurotoxicity study should include assessments of acetylcholinesterase activities in the maternal animals and offspring, in addition to protocol requirements.
- Confirmatory drinking water surveillance data may be required, pending the implementation of interim measures.

Value

- Confirmatory scientific information is being requested from the registrants and the stakeholders as a result of this re-evaluation to establish realistic phase-out periods.
- Quantitative and/or qualitative data on the economic and social importance of the phase-out of diazinon to specific industries is also requested.

Next Steps

- Before making a re-evaluation decision on Diazinon, all additional comments received from the stakeholders in response to this consultation document will be considered. Afterwards, a Re-evaluation Decision document will be published that will include the decision, the reasons for it, a summary of comments received on the proposed decision, and the PMRA's response to these comments.

- At the time of the re-evaluation decision, registrants will be asked to submit the above supplementary information to confirm or refine the current risk assessment.

Other Information

At the time that the re-evaluation decision is made, the PMRA will publish an Evaluation Report on diazinon in the context of this re-evaluation decision (based on the Science Evaluation section of this consultation document as well as REV2005-06). In addition, the test data on which the decision is based will be available for public inspection, upon application, in the PMRA's Reading Room (located in Ottawa).

Once all organophosphate pesticides have been re-evaluated, a cumulative risk assessment will be conducted, which will consider potential exposure to all chemicals causing toxicity in the same manner. The results of the cumulative risk assessment may affect any previous re-evaluation decision.

Science Evaluation

1.0 Introduction

Diazinon is a broad spectrum, non-systemic resistance management Mode of Action (MoA) Group 1B (organophosphate) insecticide, which inhibits the enzyme acetylcholinesterase, thus interrupting the transmission of nerve impulses. It works by contact, ingestion and respiratory action.

For a summary of the uses considered in the risk assessment consult Section 2.2.1 of REV2005-06 *Preliminary Risk and Value Assessments of Diazinon*. For a list of the uses not considered in the risk assessment as they were not supported by the registrants consult Section 2.2.2 of REV2005-06.

Re-evaluation Note REV2005-06, *Preliminary Risk and Value Assessments of Diazinon* can be found at:

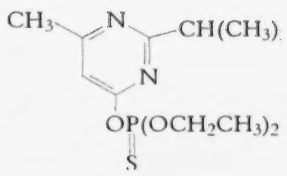
English	www.pmra-arla.gc.ca/english/pdf/rev/rev2005-06-e.pdf	or
French	www.pmra-arla.gc.ca/francais/pdf/rev/rev2005-06-f.pdf.	

2.0 The Technical Grade Active Ingredient, Its Properties and Uses

2.1 Identity of the Technical Grade Active Ingredient

Common name	Diazinon
Function	Insecticide
Chemical family	Organophosphate
Chemical name	
1. International Union of Pure and Applied Chemistry (IUPAC)	O,O-diethyl O-2-isopropyl-6-methylpyrimidin-4-yl phosphorothioate
2. Chemical Abstracts Service (CAS)	O,O-diethyl O-[6- methyl -2-(1-methylethyl)-4-pyrimidinyl phosphorothioate
CAS Registry Number	333-41-5
Molecular formula	$C_{12}H_{21}N_2O_3PS$
Molecular weight	304.3

Structural formula



Identity of relevant impurities of human health or environmental concern:

Impurities of human health or environmental concern as identified in Regulatory Directive DIR99-03, Appendix II, are not expected to be present or formed in the product.

2.2 Physical and Chemical Properties of the Technical Grade Active Ingredient

Property	Result
Vapour pressure at 25°C	1.2×10^{1} mPa*
Henry's law constant	6.09×10^{-2} Pa m^3 mol^{-1}*
Ultraviolet (UV)/visible spectrum	λ max = 247 nm
Solubility in water at 20°C	60 mg/L*
n-Octanol-water partition coefficient (log K_{ow})	Log K_{ow} = 3.30*
Dissociation constant (pKa)	pKa = 2.6*

* From "the e-Pesticide Manual" 13th Edition, Vol 3.1, 2004-2005, entry # 227

2.3 Description of Registered Diazinon Uses

Appendix I lists all diazinon products registered in Canada as of December 2006. Appendices IIa and IIb list all the Commercial Class product uses for which diazinon was registered as of December 2006. Appendix IIa identifies which uses the registrants will continue to support. Appendix IIb identifies uses not supported by the registrants.

Uses of diazinon belong to the following use site categories: forests and woodlots, greenhouse food crops, livestock for food, seed treatment for food, terrestrial feed crops, terrestrial food crops, non-crop land and outdoor ornamentals (non-residential areas).

3.0 Impact on Human and Animal Health

Toxicology studies in laboratory animals describe potential health effects resulting from various levels of exposure to a chemical and identify dose levels where no effects are observed. Unless there is evidence to the contrary, it is assumed that effects observed in animals are relevant to humans and that humans are more sensitive to effects of a chemical than the most sensitive animal species.

3.1 Toxicological Summary

For details on the toxicological assessment of diazinon, refer to Section 3.1 of REV2005-06. No additional information was received during the consultation period to alter the toxicological assessment in REV2005-06.

3.2 Occupational, Residential, Dietary and Aggregate Exposure and Risk

For details on the human exposure assessment of diazinon, refer to Section 3.2 to 3.5 of REV2005-06. No additional information was received during the consultation period to alter the conclusions of the human exposure assessments in REV2005-06.

4.0 Impact on the Environment

4.1 Fate and Behaviour in the Environment

The fate and behaviour of diazinon has been described in Re-evaluation Note REV2005-06, *Preliminary Risk and Value Assessments of Diazinon*. Although no additional information was received during the consultation period for REV2005-06, refined assessments were conducted for risk to birds, small mammals and aquatic organisms.

4.2 Effects on Non-target Species

The environmental risk assessment determines the potential for adverse ecological effects in each environmental compartment by comparing the ratio of the estimated environmental exposure to the ecotoxicological effect. The estimated environmental exposure concentration (EEC) is the initial or cumulative concentration of pesticide in the various sources of food, water and soil to which the organism is exposed. EECs are calculated by different methods for each media (food, water or soil). If multiple applications of pesticide are used, cumulative EECs are determined by using the time taken to decline to 50% of the original concentration (DT_{50}) using the minimum time interval between applications for each environmental media.

The risk assessment is initially conducted using a screening-level scenario which assumes maximum exposure (EEC) and the most sensitive toxicological endpoint for the organism of interest. This assumes direct application or over spray to the environmental media (food, water, soil) to which the organism is exposed. This is the most conservative scenario and generally over estimates the exposure to an organism when the pesticide is applied according to the label

instructions. Risk to the environment is calculated as a risk quotient (RQ) which is the ratio between the environmental exposure and the toxicological endpoint for the organism (i.e. RQ = EEC/toxicological endpoint). The level of concern is 1 (i.e. RQ = 1). RQ values greater than or equal to 1 are considered to equal or exceed the level of concern which may result in potentially harmful effects to the organism. RQ values less than 1 are not considered to be a concern to the organism because they are below the threshold for harmful effects. In the latter case, no further assessment is carried out.

If the RQ is greater than or equal to 1, then a refinement of the risk assessment is done to assess the level of concern using scenarios which are a better approximation of exposure or toxicological effects and less conservative. Refinements can include (i) exposure from the fraction of pesticide which drifts onto non-target habitats, instead of assuming 100% over spray, and (ii) exposure from the amount of pesticide predicted in runoff, instead of assuming direct application to water (i.e. 100% exposure). The refinements may also consider different toxicity endpoints or a percentile of a species sensitivity distribution rather than the most sensitive endpoint. They may also consider the results of a mesocosm study using several species rather than the toxicity from a single species. Further refinements to the risk assessment may consider the use of monitoring data collected in the field rather than EECs generated by a model.

4.2.1 Effects on Terrestrial Organisms

4.2.1.1 Foliar Applications

Diazinon is highly toxic to honeybees (*Apis mellifera*). The application rate at which 50% of the bees die was determined to be 112 g a.i./ha. The foliar spray application rates currently registered for diazinon range from 500 to 4000 g a.i./ha. Therefore, the level of concern is exceeded for honeybees and other pollinating insects from applications of diazinon when they are actively foraging.

Earthworms are determined to be at negligible risk from concentrations of diazinon in soil following all foliar applications of diazinon.

The results of a conservative screening level assessment on birds and small wild mammals is reported in Re-evaluation Note REV2005-06, *Preliminary Risk and Value Assessments of Diazinon*. The assessment concluded that diazinon poses a potential risk to birds and small wild mammals feeding on the site of application for all foliar applications.

Refined Assessment for Birds and Small Wild Mammals
A refined assessment was conducted for birds and small wild mammals which estimated the risk from feeding both on-field and in areas adjacent to a treated field, where exposure to residues from spray drift is only a fraction of the application rate. The revised assessment used a set of generic body weights for birds (20, 100, 1000 g) and mammals (15, 35, 1000 g) to represent a range of bird and small mammal species. It is noted that diets of animals can be highly variable from season to season as well as day to day. Furthermore, animals are often opportunists and if they encounter an abundant and/or desirable food source, they may consume large quantities of

that food. For these reasons, the revised assessment used relevant food categories for each size group consisting of 100% of a particular dietary item. This allowed an assessment of the risk to different sizes and food guilds of birds and small mammals including insectivores, granivores, fructivores and herbivores feeding on the site of pesticide application.

The refined assessment was conducted using species sensitivity distributions (SSDs) for the acute oral and dietary bird toxicity data for diazinon instead of the most sensitive species endpoints that were used in the screening level assessment. The 5th percentile of the species sensitivity distribution (referred to as the $LD_{50}^{5th\ percentile}$) was used to characterize the risk. Choosing the 5th percentile of the species sensitivity distribution means that for 95% of species, the chemical is expected to be less toxic than the estimated toxicity value (i.e. actual LD_{50} value is expected to be $> LD_{50}^{5th\ percentile}$) and for 5% of species, the chemical may be more toxic than the estimated toxicity value (i.e. actual LD_{50} value is expected to be $< LD_{50}^{5th\ percentile}$). The acute oral and dietary risk quotients (estimated daily exposure (EDE)/$LD_{50}^{5th\ percentile(50\%)}$) for birds feeding on the site of pesticide application show that the level of concern (LOC) is exceeded for all of the foliar use-patterns of diazinon. The risk quotients exceeded the level of concern by a factor of 1 to 358. The exceedences were greatest for large herbivores such as ducks and geese.

The chronic risk quotients (EDE/$NOEL^{5th\ percentile(50\%)}$) for birds feeding on the site of pesticide application show that the level of concern is exceeded for all foliar applications of diazinon. The risk quotients exceeded the level of concern by a factor of 5 to 2508. The exceedences were greatest for large herbivores such as ducks and geese. The level of concern is also exceeded for birds feeding in terrestrial habitats adjacent to the site of application for all foliar applications of diazinon, indicating that they would also be at risk from chronic exposure to diazinon.

A refined risk assessment for small wild mammals was conducted using a SSD for the acute oral mammal toxicity data instead of the most sensitive toxicity endpoint used in the screening level assessment. The acute oral risk quotients (EDE/$LD_{50}^{5th\ percentile(50\%)}$) for small wild mammals feeding on the site of pesticide application show that the level of concern is only exceeded for herbivores for all foliar applications of diazinon. The risk quotients exceeded the level of concern by a factor of 1 to 16. The level of concern is also exceeded for small wild mammal herbivores feeding in terrestrial habitats adjacent to air blast applications of diazinon on Christmas tree plantations, apple/pears, stone fruit and Holly. The risk quotients exceeded the level of concern by a factor of 1 to 12.

The chronic toxicity endpoint (NOEL) used in the chronic mammal risk assessment measured decreased parental and pup weight gain and pup mortality. The chronic risk quotients (EDE/$NOEL^{5th\ percentile(50\%)}$) for small wild mammals feeding on the site of pesticide application show that the level of concern is exceeded for all of the foliar applications of diazinon. The risk quotients exceeded the level of concern by a factor of 2 to 1967. The exceedences were greatest for herbivores. The chronic risk quotients (EDE/$NOEL^{5th\ percentile(50\%)}$) for small wild mammals feeding adjacent to the site of pesticide application show that the level of concern is exceeded for all foliar applications of diazinon with the exception of 1000 gram insectivores and granivores following groundboom applications on lettuce. The risk quotients exceeded the level of concern by a factor of 1 to 1455. The exceedences were greatest for herbivores.

To determine the risk to birds and small wild mammals consuming contaminated food items in terrestrial habitats adjacent to sites where diazinon was applied, the spray drift data of Wolfe and Caldwell (2001) was used to determine that the 90th percentile deposit into a habitat adjacent to a field sprayed using ground boom equipment (fine droplet size ASAE) will not exceed 11% of the application rate. Similarly, it was estimated from the data of Ganzelmeier et al. (1995) that the 95th percentile deposit into a habitat adjacent to an orchard sprayed using air blast equipment will not exceed 74% of the applied application rate for early applications and 59% of the applied application rate for late applications. The acute oral and dietary risk quotients (estimated daily exposure (EDE)/$LD_{50}^{5th\ percentile(50\%)}$) show that the level of concern is exceeded for birds feeding in terrestrial habitats adjacent to the site of all foliar applications with the exception of 1000 gram insectivores and granivores following ground boom applications of diazinon on lettuce, tomatoes and carnations. The risk quotients exceeded the level of concern by a factor of 1 to 265. The exceedences were greatest for large herbivores such as ducks and geese.

The risk assessment for birds and small wild mammals addressed exposure through the consumption of contaminated food items only, however exposure to diazinon following foliar applications can also occur by dermal and inhalation routes. The risk to these organisms may, therefore, be underestimated. This is a source of uncertainty in the risk assessment. Currently, the PMRA is exploring acceptable methods to assess the potential risk associated with inhalation and dermal routes of exposure to birds and small wild mammals.

4.2.1.2 Granular Applications

An assessment was carried out previously; see Re-evaluation Note REV2005-06, *Preliminary Risk and Value Assessments of Diazinon*. Granular applications of diazinon are a high risk for small birds and wild mammals since the consumption of very few granules (5 granules for a small bird) is required to reach the dose causing 50% mortality in the test population (LD_{50}). This assessment is not considered conservative since the consumption of this number of granules is quite possible. Field studies conducted in the United States have demonstrated that granular applications of diazinon can adversely affect birds and small wild mammals in the treatment area. The EPA is cancelling all granular applications of diazinon as a result of their risk assessment.

4.2.1.3 Seed Treatment

An assessment was carried out previously; see Re-evaluation Note REV2005-06, *Preliminary Risk and Value Assessments of Diazinon*. Seed treatments also pose a high risk to small birds since the number of treated seeds that need to be consumed in order to reach the LD_{50} is very small (1 to 20 seeds). This assessment is not considered conservative since the consumption of this number of seeds is quite realistic. The EPA is cancelling all seed treatments of diazinon as a result of their risk assessment.

4.2.2 Effects on Aquatic Organisms

Further to the earlier assessment (REV2005-06), a more refined assessment of effects on aquatic organisms has been conducted for foliar applications of diazinon.

Refined Assessment for Aquatic Organisms
Aquatic organisms may be exposed to residues of diazinon initially from drift immediately following ground application and subsequently from runoff following rainfall events. A refined aquatic risk assessment for all foliar applications was conducted beginning with a screening level assessment.

The EECs in the screening level assessment were calculated using a direct application to a water body 80 cm deep to assess the risk to aquatic organisms, with the exception of amphibians which uses a 15 cm depth to simulate a seasonal water body. The calculated risk quotients (RQs) indicate that the level of concern (LOC = 1) is exceeded for both acute and chronic exposures for freshwater and estuarine and marine invertebrates, freshwater and estuarine and marine fish and amphibians (based on surrogate data from fish) for all foliar applications. The acute RQ's for freshwater aquatic invertebrates, freshwater fish, estuarine and marine invertebrates, estuarine and marine fish and amphibians exceed the level of concern by factors of 1380 to 9380, 8 to 52, 29 to 195, 5 to 31 and 41 to 278, respectively. The chronic RQs for freshwater aquatic invertebrates, freshwater fish, estuarine and marine fish and amphibians exceed the level of concern by factors of 688 to 2759, 213 to 853, 300 to 1203 and 1138 to 4545, respectively. Further refinements were conducted for these species. The level of concern is not exceeded for freshwater algae, therefore no further refinement was required.

As for the terrestrial risk assessment, the spray drift data of Wolfe and Caldwell (2001) and Ganzelmeier et al. (1995) was used to determine the deposit resulting from spray drift into an aquatic habitat adjacent to a field sprayed using ground boom and air blast spray equipment. The calculated risk quotients indicate that the level of concern (LOC = 1) is exceeded for both acute and chronic exposures for freshwater and estuarine and marine invertebrates, fish and amphibians (based on surrogate data from fish) for all foliar applications. The acute RQs for freshwater aquatic invertebrates, freshwater fish, estuarine and marine invertebrates, estuarine and marine fish and amphibians exceed the level of concern by factors of 160 to 4640, 1 to 39, 3 to 145, 1 to 23, and 4 to 206, respectively. The chronic RQ's for freshwater aquatic invertebrates, freshwater fish, estuarine and marine fish and amphibians exceed the level of concern by factors of 77 to 2041, 24 to 631, 33 to 890 and 125 to 3364, respectively. Therefore, despite the large decreases in exposure from this refinement the level of concern was still exceeded by very large margins for most aquatic organisms.

Aquatic organisms can also be exposed to diazinon from foliar applications as a result of run-off into a body of water. Modelling was not used to estimate exposure to aquatic organisms from runoff because Canadian water monitoring data, which provide a compilation of all sources of exposure, were available and were used to characterize the risk. The use of monitoring data in a risk assessment is accompanied with some uncertainty. The depth of the water bodies where concentrations were measured is unknown, the distance from the site of application of diazinon is

unknown, and the time the samples were taken following a rainfall event is also unknown. This may result in an underestimate of surface water concentrations, and hence risk, in some situations. The Canadian monitoring data consisted of 544 detections from surface waters in British Columbia, Alberta, Ontario and Quebec. The monitoring data used for the acute assessment consisted of two concentrations (25 µg a.i./L which was the maximum amount detected in surface water in Canada from the Niagara fruit belt, and 5.8 µg ai/L, which is the 95th percentile value for acute exposure from all of the surface water detections). A concentration of 0.43 µg ai/L was used for the chronic risk assessment which is the 95th percentile value for chronic exposure (excluding non-detects) from the Canadian surface water monitoring data. The calculated risk quotients indicate that the level of concern (1) is exceeded for both acute and chronic exposures for freshwater and estuarine and marine invertebrates. The acute RQs for freshwater aquatic invertebrates and estuarine and marine invertebrates exceed the level of concern by factors of 116 to 500 and 2 to10, respectively. The chronic RQ for freshwater aquatic invertebrates exceeds the level of concern by a factor of 3.

The level of concern is exceeded by a factor of 3 for the maximum acute value (25 µg a.i./L), but is not exceeded for the 95th percentile acute and chronic values for freshwater fish. The level of concern is exceeded by a factor of 2 for the maximum acute value (25 µg a.i./L) and by a factor of 1 for the 95th percentile chronic value (0.43 µg ai/L), but is not exceeded for the 95th percentile acute value for estuarine and marine fish. The level of concern is exceeded by a factor of 3 for the maximum acute value (25 µg a.i./L), but is not exceeded for the 95th percentile acute and chronic values for amphibians.

5.0 Value

5.1 Value of Diazinon

The value of diazinon was discussed in REV2005-06 and stakeholder input was requested. The comments received indicated that additional uses were considered of value, as summarized below.

5.1.1 Diazinon Uses (in addition to those identified in REV2005-06) for Which Comments on Value were Received

5.1.1.1 Cherries

The following issues were identified by growers:

a) Diazinon when used with dormant oil will provide effective control of apple mealybug which acts as a vector of little cherry disease.

b) Diazinon has a wider pest spectrum than several of the alternatives for cherry fruit fly and black cherry aphid. The loss of diazinon will require several insecticidal sprays to control the same pests as would be controlled by one application of diazinon.

c) Concern has been expressed that some of the registered alternatives to diazinon (e.g. carbaryl and imidacloprid) may cause secondary pest outbreaks (e.g. phytophagous mites).

d) Maximum residue limits for diazinon in cherries are generally established in global markets. Concern has been expressed that the alternative active ingredients to diazinon registered in Canada may limit the export market(s) available to growers as a result of:

- The lack of established maximum residue limits in importing countries for products recently registered in Canada; and

- The potential loss of maximum residue limits in the European Union for alternative active ingredients to diazinon which are currently under re-evaluation. Loss of the European market would be devastating to the British Columbia cherry export market.

e) Concerns were expressed regarding the availability and limitations of registered alternatives to diazinon to control pests on cherries. Table 5.1.1.1 summarizes the alternative active ingredients registered in Canada to diazinon for the control of cherry fruit fly, black cherry aphid and mealybug (a scale insect) on cherries.

Table 5.1.1.1 Summary Table of Registered Alternative Active Ingredients to Diazinon for the Control of Cherry Pests, as of 15 December 2006

Pest	Registered Alternatives to Diazinon (Resistance Mode of Action (MoA) group)[1]
cherry fruit fly	• (1A): carbaryl[2, 3] • (1B): azinphos-methyl[4], dimethoate[2,5], phosalone[2], phosmet[2,6] • (3): cyhalothrin-lambda • (4): imidacloprid[7] • (5): spinosad [8]
black cherry aphid	• (1A): carbaryl[2, 3] • (1B): malathion[2,9], phosalone[2] • (2A): endosulfan[2] • Other: insecticidal soap[10]
mealybug	• (1A): carbaryl[2, 3] (scale insects) • (Other): insecticidal soap[10]

1 1A = acetylcholinesterase inhibitors (carbamates); 1B = acetylcholinesterase inhibitors (organophosphates); 2A = gamma-aminobutyric acid (GABA) gated chloride channel antagonists; 3 = sodium channel modulators; 4 = acetylcholine receptor agonists/antagonists; and 5 = acetylcholine receptor modulators.

2 This active ingredient is currently under re-evaluation.

3 Carbaryl can be harmful to beneficial insects.

4 Use of azinphos-methyl on cherries is proposed to be phased out by 31 December 2007 as published in REV2006-04.

5 Dimethoate is phytotoxic to certain varieties of cherries.

6 Phosmet is registered for use on sour cherries only.

7 Imidacloprid is registered for use in Ontario and British Columbia only, and may cause an increase in mite populations.

8 Comments were received by the PMRA regarding the limitation of spinosad to 4 applications per year, at a 5-day interval (when conditions are rainy or when fruit is ripening), which is insufficient to protect the crop for the duration when cherry fruit fly is present and may cause damage. Cherry fruit fly adults emerge from June through August and must be controlled prior to oviposition. Extended protection of the crop from cherry fruit fly is required as there is a zero tolerance for fruit fly in cherries which is a quarantine pest in Canada and other countries. Since grower comments were received in response to REV2005-06, a spinosad bait treatment has been registered in 2006 having a total of 10 applications per season.

9 Malathion is phytotoxic to certain varieties of cherries.

10 Insecticidal soap is registered to control aphids and scale insects on cherries, however, due to the short residual activity and potential for phytotoxicity from repeated applications, it is not considered a viable alternative to diazinon.

5.1.1.2 Vegetable and Fruit Crops

The PMRA received comments regarding the use and value of diazinon on several vegetable and fruit crops. Appendix III lists the crop-pest combinations for which the stakeholders provided comments indicating the uses in addition to those identified in REV2005-06 that were considered of value.

Comments from the stakeholders regarding the value of diazinon include:

- lack of availability of registered alternatives;
- for some crop-pest combinations, loss of diazinon will reduce by one the number of Mode of Action (MoA) groups, which may result in the inability to rotate between MoA groups for the purposes of delaying the development of insecticide resistance;
- for apples, in addition to the concerns above, the loss of diazinon may result in:
  a) an increased number of substitute selective insecticide sprays; and
  b) secondary pest outbreaks due to overuse of the registered alternatives.
- for onions, diazinon sprays to control onion maggot:
  a) are needed to continue to target both adults and larvae;
  b) will also control secondary pests, such as thrips; and
  c) may also provide protection from the leek moth, a newly introduced pest in Ontario.

5.1.2 Diazinon Uses for which Comments were Received Indicating that Registered Alternatives are Available, or Diazinon is Rarely Used

Information was provided indicating the phase-out of diazinon would likely have little impact on:

- lettuce to control aphids;
- radish to control aphids; and
- spinach to control aphids and leafminers.

5.1.3 Diazinon Uses for Which no Comments were Received

No comments were received in response to the request for information on value and use in REV2005-06 for the following crops:

- mushroom houses;
- Christmas tree plantations;
- outdoor ornamentals (commercial production);
- stone fruits (apricot, peach);
- pear;
- bean;
- leafy vegetables (collard, Swiss chard);
- cucurbits (cucumber, melon, squash);
- grape; and
- hops.

6.0 Toxic Substances Management Policy Considerations

See Re-evaluation Note REV2005-06, *Preliminary Risk and Value Assessments of Diazinon*. It has been determined that diazinon does not meet the TSMP Track 1 criteria. Data are not available to determine the Toxic Substances Management Policy (TSMP) status of the transformation products oxypyrimidine and diazoxon.

7.0 Summary

7.1 Human Health and Safety

Dietary risks from food and water are not of concern. Human exposure to diazinon, including that of the most highly exposed subpopulation (e.g. children 1 to 6 years old), was estimated from residues in treated food commodities. This dietary exposure represents less than 31% of the chronic reference dose. Based on the available surveillance data, exposure that may occur from drinking water is not of concern. However, additional confirmatory data may be required.

The proposed phase-out of the uses listed in Appendix IV will reduce worker risk. During the phase-out period and for any on-going uses, additional PPE, implementation of closed mix/loading systems are proposed to mitigate worker risk. Postapplication risks are addressed by revising restricted entry intervals.

For additional detail, refer to REV2005-06.

7.2 Environmental Risk

Diazinon is slightly persistent in soils and non-persistent in aquatic systems. Diazinon will volatilize from moist surfaces and water. Available Canadian monitoring data indicate that diazinon is readily reaching surface water within Canada. The maximum surface water concentration detected in Canada was reported as 25 µg a.i./L. Oxypyrimidine was identified as the primary transformation product and was observed to leach to a depth of 180 cm, which may be a concern for groundwater contamination.

The level of concern is exceeded for honeybees and other pollinating insects when they are actively foraging following all application scenarios of diazinon.

All foliar applications of diazinon pose an acute and chronic risk to birds feeding on the site of application. Birds feeding in terrestrial habitats adjacent to the site of all foliar applications are also at acute risk due to consumption of contaminated food items resulting from spray drift, with the exception of large insectivores and granivores following groundboom applications on lettuce, tomatoes and carnations. Foliar applications of diazinon pose an acute risk to small herbivorous wild mammals and a chronic risk to small wild mammals feeding on the site of application. Small herbivorous wild mammals feeding in terrestrial habitats adjacent to the site

of application are also at acute risk following all air blast applications. Small wild mammals feeding in terrestrial habitats adjacent to the site of application are at chronic risk following all foliar applications with the exception of insectivores and granivores following groundboom applications on lettuce.

Granular applications of diazinon present a high risk to small birds as it would require the consumption of as few as five granules to reach the LD_{50}. The risk is not as high for larger birds such as the mallard duck and Canada goose. The number of granules that would need to be consumed in order to reach the LD_{50} are 464 and 1228 for the mallard and Canada goose, respectively. The level of concern is also exceeded for small mammals following granular applications of diazinon. Field studies conducted in the United States have demonstrated that granular applications of diazinon can adversely affect birds and small wild mammals in the treatment area.

Seed treatments also pose a high risk to small birds. The number of treated seeds that need to be consumed in order to reach the LD_{50} is very small (1 to 20 seeds). The risk is not as high for small wild mammals. The number of seeds a mouse would need to consume to reach the LD_{50} range from 420 to 7180 depending on the type of seed treated.

All foliar applications of diazinon pose a risk to aquatic invertebrates, amphibians, and fish. The calculated risk quotients indicate that the level of concern is exceeded for both acute and chronic exposures from the spray drift component to freshwater and estuarine and marine invertebrates, fish and amphibians (based on surrogate data from fish) for all foliar applications. The calculated risk quotients using Canadian surface water monitoring data indicate that the level of concern is exceeded for both acute and chronic exposures to freshwater and estuarine and marine invertebrates and estuarine and marine fish and for acute exposures to freshwater fish and amphibians (based on surrogate data from fish) for all foliar applications. It should be noted that monitoring data is considered to be a lower bound estimate of peak concentrations and likely underestimates exposure, especially acute exposure.

7.3 Value

Diazinon is used extensively in agriculture. It is the only registered chemical to control some pests on several crops. Diazinon is essential for management of insect resistance to pesticides for those site-pest combinations limited to one alternate resistance management Mode of Action (MoA) group to diazinon.

Comments were provided by the stakeholders for the value and use of diazinon for the following crops: fruits (apple, blackberry, cherry, cranberry, currant, gooseberry, raspberry and strawberry), vegetables (beet, carrot, cole crops (broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi), lettuce, onion, parsley, parsnip, pepper, radish, rutabaga, turnip and tomato) and tobacco for greenhouse grown seedlings for transplant.

No comments were received in response to the request in REV2005-06 for information on value and use for the following crops: mushroom, Christmas trees, outdoor ornamentals (commercial production), stone fruit (apricot, peach), pear, bean, leafy vegetables (collard, Swiss chard), cucurbits (cucumber, melon, squash), grape and hops.

8.0 Proposed Regulatory Decision

The PMRA has determined that certain diazinon uses of products currently for sale and use in Canada are acceptable for continued registration. These uses have value in the food and crop industry and do not involve a level of concern to human health or the environment. These uses are application by ear tag on cattle; and application of emulsifiable concentrate and wettable powder products by groundboom soil drench on blackberry, broccoli, Brussels sprouts, cabbage, cauliflower, loganberry, onion, raspberry, rutabaga, turnip (see Appendix IV). As a condition of the continued registration of these uses, new risk-reduction measures must be included on the labels of certain diazinon products. In addition, registrant must submit additional scientific information.

The remaining uses of diazinon are proposed for phase-out as registrants do not support continued registration or because of the human health risks and/or risks to the environment. These diazinon uses include air blast application on Christmas tree plantations; uses on greenhouse pepper and tomatoes, mushroom houses and tobacco seedling; all uses of granular formulation on food crops; seed treatments for beans (including soybean), corn, onion, peas, potato, radish and sugar beet; and all foliar sprays on food and feed crops and outdoor ornamentals. Based on the conclusions of the assessments, diazinon uses and application methods were categorized as requiring either short term or longer term phase-out.

Short term phase-out is proposed for uses which are not supported by the registrants, or for uses supported by the registrants for which registered alternatives are currently available and:

- uses were not identified as "Key" uses in REV2005-06; or
- no comments were received in response to consultation for REV2005-06; or
- where comments were received indicating the loss of diazinon would result in little impact.

Longer term phase-out is proposed for the supported crop uses where:

- the information available to the PMRA indicated that the loss of diazinon for the control of registered pests would result in significant crop injury; or
- viable alternative active ingredients are not available; or
- there are no registered alternative active ingredients; or
- risk concerns can be mitigated to the extent possible with interim measures.

These longer time frames are proposed for some application methods to Christmas tree plantation, greenhouse tobacco seedlings, apple, blackberry, carrot, cherry, cranberry, currant, gooseberry, loganberry, onion, parsnip, radish, raspberry, rutabaga, strawberry and turnip.

The PMRA is proposing that these uses be permitted until the end of 2012 to allow for transition to alternative pest management tools. In the interim, measures to mitigate risk to workers and the environment will be implemented for these crops. The PMRA will accept written comments on the proposed phase-out of the uses of diazinon and will also consult with stakeholders to identify transition needs.

Within 90 days of a final decision, registrants will be required to submit applications for label amendments to remove uses designated for short-term phase-out, and to implement mitigation measures for remaining uses or uses designated for longer-term phase-out.

8.1 Proposed Regulatory Actions

8.1.1 Proposed Regulatory Action Related to Human Health

The PMRA has determined that the dietary and drinking water risks, worker risks during mixing, loading and application are acceptable for uses not proposed for phase-out, provided that the mitigation measures listed in this Section 8.1.1.2 are implemented. During the phase-out period and for any on-going uses, additional PPE, implementation of closed mix/loading systems are proposed to mitigate applicator risk. Postapplication risks are addressed by revising restricted-entry intervals (REI), as outlined in REV2005-06.

8.1.1.2 Proposed Mitigation for Mixer, Loader and Applicator Exposure

For uses deemed acceptable for continued registration, the following mitigation measures and label statements are proposed.

A. Cattle ear tags

Applicators must wear chemical-resistant gloves during application and removal of the device.

B. Label requirements for mixers/loaders

Wettable powder formulations (must be packaged in water soluble bags)

Mixers/loaders must wear:

- long-sleeved shirt and long pants
- socks and shoes
- chemical-resistant gloves

Mixers and loaders using water-soluble packets must have additional PPE immediately available for use in emergency (such as broken package, spill or equipment breakdown). These PPE include coveralls and chemical-resistant footwear and a non-powered air purifying respirator equipped with an -R or -P series filter.

Liquid formulations

Mixers/loaders must use a closed mechanical transfer loading system. Mixers/loaders must wear:

- long-sleeve shirt and long pants
- socks and shoes
- chemical resistant gloves

If a closed loading system is not available, mixers/loaders must wear:

- chemical-resistant coveralls over long-sleeved shirt and long pants
- chemical-resistant gloves
- chemical-resistant footwear
- an air purifying respirator equipped with an -R or -P series filter

Mixers and loaders must have additional PPE immediately available for use in emergency (spill or equipment breakdown). These PPE include coveralls and chemical-resistant footwear and a non-powered air purifying respirator equipped with an -R or -P series filter.

C. Label requirements regarding applicators

Open cab groundboom applications are not permitted.

Applicators using groundboom equipment with a closed cab must wear:

- long-sleeved shirt and long pants
- chemical-resistant gloves when leaving cab for clean up and repair
- socks and shoes

Applicators using airblast equipment with a closed cab must wear:

- long-sleeved shirt and long pants
- socks and shoes

Applicators using handheld equipment, including paintbrushes, must wear:

- long-sleeved shirt and long pants
- chemical-resistant coveralls and head protection (if spray is upward directed)
- chemical-resistant gloves
- chemical-resistant footwear
- an air purifying respirator with an -R or -P series filter

8.1.1.3 Residue Definition for Risk Assessment and Enforcement

No change is proposed for the existing residue definition for diazinon in Table II, Division 15 of the Food and Drugs Regulations, which specify the parent compound O,O diethyl-O-(2-isopropyl-6-methyl-4-pyrimidinyl) phosphorothioate. The residue definition is harmonized with that of the US and Codex.

8.1.1.4 Maximum Residue Limits for Diazinon in Food

In general, when the re-evaluation of a pesticide has been completed, the PMRA intends to update Canadian MRLs and to remove MRLs that are no longer supported. In the situation where uses are phased out or voluntarily discontinued, the PMRA would allow a suitable time period to allow treated commodities to clear channels of trade before revocation of the corresponding MRL. The PMRA recognizes, however, that interested parties may want to retain an MRL in the absence of a Canadian registration to allow legal importation of treated commodities into Canada. Where no dietary risk has been identified, existing MRLs may be allowed to continue. Parties interested in supporting a diazinon MRL should contact the PMRA during the comment period of this document to discuss the submission of appropriate data.

The PMRA requires similar chemistry and toxicology data for such import MRLs as those required to support Canadian food use registrations. In addition, the PMRA requires residue data that are representative of use conditions in exporting countries, in the same manner that representative residue data are required to support domestic use of the pesticide. These requirements are necessary so that the PMRA may determine whether the requested MRLs are needed and to ensure they would not result in unacceptable health risks.

After the revocation of an MRL or where no specific MRL for a pest control product has been established in the Food and Drug Regulations, subsection B.15.002(1) applies. This requires that residues do not exceed 0.1 ppm and has been considered a general MRL for enforcement purposes. However, changes to this general MRL may be implemented in the future, as indicated in Discussion Document DIS2006-01, *Revocation of 0.1 ppm as a General Maximum Residue Limit for Food Pesticide Residues [Regulation B.15.002(1)]*.

The Food and Drug Regulations specify MRLs for residues of diazinon in or the commodities and at the levels indicated in Table 8.1.1.4. Residues in all other agricultural commodities, including those approved for treatment in Canada but without a specified MRL must not exceed the general MRL of 0.1 ppm.

Table 8.1.1.4 Diazinon MRLs for Commodities Approved in Canada

Commodity	MRL (ppm)
Apples, apricots, beets, broccoli, cabbage, carrots, cauliflower, celery, cherries, endives, grapes, kale, kohlrabi, lettuce, onions, pears, peppers, plums, salsify, spinach, strawberries, tomatoes, turnip tops, wasabi	0.75
Citrus fruits, peaches/nectarines	0.7
Beans, Brussels sprouts, cucumbers, turnips	0.5
Cantaloupes, collards, cranberries, figs, hopss, lima beans, muskmelons, parsley, parsnips, radishes, summer squash, Swiss chard, watermelons, winter squash	0.25

8.1.2 Proposed Regulatory Action Related to Environment

The risk assessment of diazinon indicates that adverse effects on pollinators, birds, small wild mammals, aquatic invertebrates, fish, and amphibians are anticipated. The risk to birds and small wild mammals from granular applications, seed treatments and all foliar applications cannot be mitigated, therefore a phase-out of these use-patterns is proposed. The environmental risks are determined to be acceptable for ear tag use on cattle and soil drench applications on blackberry, loganberry, raspberry, onion, rutabaga, turnip and cole crops (broccoli, cabbage, brussels sprouts, cauliflower).

8.2 Additional Data Requirements

8.2.1 Data Requirements Related to Toxicology

Diazinon is a neurotoxicant in adult animals, with acetylcholinesterase inhibition as the most sensitive endpoint of concern. The toxicology database lacks a developmental neurotoxicity study, which is required in order to refine the toxicology risk assessment. The developmental neurotoxicity study should include assessments of acetylcholinesterase activities in the maternal animals and offspring, in addition to protocol requirements.

8.2.2 Data Requirements Related to Occupational Exposure Assessment

Although no additional information was received during the consultation period for the *Preliminary Risk and Value Assessments of Diazinon*, Re-evaluation Note (REV2005-06), the possibility of refining the worker exposure remains, as identified in Section 3.2.1, 3.2.2 and 7.1 of REV2005-06. Any additional information in the following areas may result in a refinement of the occupational exposure assessment for diazinon:

- percentage of crop treated with diazinon to control a given pest
- typical area treated per day with diazinon for both farmers and custom applicators
- border spray practices
- integrated pest management practices
- application equipment practices
- post-application practices

8.2.3 Data Requirements Related to Food Residue Chemistry

Additional crop residue data reflecting Canadian growing zones and application rates may be required to amend MRLs for food commodities or to support future use expansions.

8.2.4 Data Requirements Related to Value

Confirmatory scientific information is required from the registrants and the stakeholders to establish feasible phase-out periods.

Quantitative and/or qualitative data are required on the socio-economic impact of the phase-out of diazinon to specific industries.

List of Abbreviations

ADI	acceptable daily intake
a.i.	active ingredient
ARfD	acute reference dose
ARI	aggregate risk index
ARTF	Agricultural Re-entry Task Force
atm	atmosphere(s)
bw	body weight
CAS	Chemical Abstracts Service
CFIA	Canadian Food Inspection Agency
cm	centimetre(s)
CSFII	Continuing Survey of Food Intakes by Individuals
d	day(s)
DACO	data code
DEEM™	Dietary Exposure Evaluation Model
DER	Data Evaluation Report
DFR	dislodgeable foliar residue
DT_{50}	dissipation time to 50%
DWLOC	drinking water level of comparison
EEC	expected environmental concentration
EP	end-use product
EXAMS	Exposure Analysis Modeling System
F_0	parental generation
F_1	first filial generation
F_2	second filial generation
g	gram(s)
GAP	Good Agricultural Practice
h	hour(s)
ha	hectare
HAP	hours after application
IPM	integrated pest management
IRED	Interim Reregistration Eligibility Decision
kg	kilogram(s)
K_{oc}	organic carbon partition coefficient
K_{ow}	*n*-octanol–water partition coefficient
L	litre(s)
LEACHM	Leaching Estimation and Chemistry Model
LC_{50}	lethal concentration to 50%
LD_{50}	lethal dose to 50%
LOAEL	lowest observed adverse effect level
LOD	limit of detection
LOEC	lowest observed effect concentration
LOEL	lowest observed effect level
m	metre(s)
m^3	metre(s) cubed

min	minute(s)
mg	milligram(s)
mm	millimetre(s)
mm Hg	millimetre mercury
MOE	margin of exposure
MRL	maximum residue limit
NOAEC	no observed adverse effect concentration
NOAEL	no observed adverse effect level
NOEC	no observed effect concentration
NOEL	no observed effect level
nm	nanometre
OC	organic carbon
OP	organophosphate
PACR	Proposed Acceptability for Continuing Registration
PCPA	*Pest Control Product Act*
PDI	potential daily intake
PHI	preharvest interval
pH	-log10 hydrogen ion concentration
PHED	Pesticide Handlers Exposure Database
pKa	-log10 acid dissociation constant
PMRA	Pest Management Regulatory Agency
PPE	personal protective equipment
ppb	parts per billion
ppm	parts per million
PRVD	Proposed Re-evaluation Decision
PRZM	Pesticide Root Zone Model
Q_1*	cancer potency factor
RED	Reregistration Eligibility Decision
REI	restricted-entry interval
ROC	residue of concern
RQ	risk quotient
TC	transfer coefficient
TGAI	technical grade active ingredient
TSMP	Toxic Substances Management Policy
URMULE	User Requested Minor Use Label Expansion
USEPA	United States Environmental Protection Agency
USDA	United States Department of Agriculture
USFDA	United States Food and Drug Administration

Appendix I Registered Diazinon Products as of 11 December 2006[a]

Registration Number	Marketing[1] Class	Registrant	Product Name	Formulation Type[2]	Guarantee[3]
20963	T	MAKHTESHIM AGAN OF NORTH AMERICA INC.	DIAZOL TECHNICAL	SN	DIA-94%
22584	T	SYNGENTA CROP PROTECTION CANADA INC.	DIAZINON TECHNICAL INSECTICIDE	SN	DIA-95%
20964	M	MAKHTESHIM AGAN OF NORTH AMERICA INC.	DIAZOL OIL MANUFACTURING CONCENTRATE	SN	DIA-87%
22751	M	SYNGENTA CROP PROTECTION CANADA INC.	DIAZINON MG 87% INSECTICIDE	SN	DIA-87%
11889	C	UNITED AGRI PRODUCTS CANADA INC.	DIAZINON 500 E	EC	DIA-500 g/L
12538	C	UNITED AGRI PRODUCTS CANADA INC.	DIAZINON 5G INSECTICIDE	GR	DIA-5%
14986	C	NORAC CONCEPTS INC.	DCT DUAL PURPOSE SEED TREATMENT POWDER	WP	DIA-6% TPM-14% CAP-18%
15755	C	INTERPROVINCIAL COOPERATIVE LIMITED	CO-OP POTATO SEED PIECE TREATMENT	DU	DIA-0.1% CAP-7.5%
15897	C	MAKHTESHIM AGAN OF NORTH AMERICA INC.	DIAZOL 50W WETTABLE POWDER INSECTICIDE	WP	DIA-50%
15921	C	MAKHTESHIM AGAN OF NORTH AMERICA INC.	DIAZOL 50 EC	EC	DIA-50%
16518	C	NU-GRO PR INC.	WILSON DIAZINON 50 EC	EC	DIA-500 g/L
19576	C	UNITED AGRI PRODUCTS CANADA INC.	DIAZINON 50 W INSECTICIDE	WP	DIA-50%
23004	C	VÉTOQUINOL N.-A. INC.	PROTECTOR EAR TAGS	SR	DIA-20%
24438	C	VÉTOQUINOL N.-A. INC.	ELIMINATOR EAR TAG	SR	DIA-11% CYM-6%

Registration Number	Marketing[1] Class	Registrant	Product Name	Formulation Type[2]	Guarantee[3]
25334	C	Y-TEX CORPORATION	Y-TEX OPTIMIZER INSECTICIDE CATTLE EAR TAG	SR	DIA-20%
26146	C	SYNGENTA CROP PROTECTION CANADA INC.	DZN 600EW INSECTICIDE	SN	DIA-600 g/L
26956	C	NORAC CONCEPTS INC.	AGROX B-2 DUAL PURPOSE SEED TREATMENT WETTABLE POWDER	WP	DIA-11.0% CAP-33.5%
26957	C	NORAC CONCEPTS INC.	AGROX CD DUAL PURPOSE SEED TREATMENT POWDER	SO	DIA-15% CAP-15%
27538	C	INTERPROVINCIAL COOPERATIVE LIMITED	DIAZINON 50 EC INSECTICIDE	EC	DIA-50%

[a] Excluding discontinued products or products with a submission for discontinuation

[1] T = Technical Grade Active Ingredient; M = Manufacturing Concentrate; C = Commercial Class product.

[2] EC = emulsifiable concentrate or emulsion; DU = dust or powder; GR = granular; SO = solid; SN = solution; SR = slow release generator; WP =wettable powder

[3] DIA = diazinon; CAP = captan; CYM = cypermethrin; TPM = thiophanate methyl.

Appendix IIa Registered Commercial Class Uses of Diazinon Supported by the Technical Registrants as of December 2006

Site	Application Method	Application Rate[1] (g a.i.)	Maximum # Applications/ year[2]	Minimum Period Between Applications	Pre-harvest Interval (days)
Greenhouse food crops tobacco seedlings, mushroom houses	**tobacco seedlings** backpack/hand held sprayer	6.25/100 m^2	2	14 days	Not applicable
	mushroom houses backpack/hand held sprayer (wall treatment)	500–1000/100 L	1	Not applicable	Not stated
	mushroom houses paint brush (bed, post and door treatment)	50–1000/100 L	Reapply as necessary *(1)*	Reapply as necessary	
Livestock (food)	1–2 ear tags (slow release)	1.15–6/head	1	Not applicable	0
Seed treatment beans (including soybeans), corn, peas	seed treatment equipment (dry and slurry)	30–31.25/100 kg seed	1	Not applicable	Not applicable

Site	Application Method	Application Rate[1] (g a.i.)	Maximum # Applications/ year[2]	Minimum Period Between Applications	Pre-harvest Interval (days)
Food crops apple, apricot, beans, beets, blackberry, broccoli, Brussels sprouts, cabbage, cauliflower, carrot, cherry, collards, cranberry, cucumber, currant, gooseberry, grapes, hopss, kale, kohlrabi, lettuce, loganberry, melons, onion, parsley, parsnip, peach, pear, raspberry, radish, rutabaga, spinach, squash, strawberry, Swiss chard, turnip, tomato	Ground application: hydraulic sprayer, seedling drench, soil drench	250–3750/ha	Reapply as necessary *(1) beans, beet, broccoli, Brussels sprouts, cabbage, cauliflower, collards, currant, gooseberry kale, kohlrabi, rutabaga, strawberry, turnip,* *(2) apple, apricot, blackberry, carrot, cherry, cucumber, grape, hopss, lettuce, loganberry, melon, parsley, parsnip, peach, pear, raspberry, spinach, squash, Swiss chard, tomato* *(3) onion* *(4) cranberry*	Reapply as necessary except for: 7 days (tomato)	1 (tomato) 3 (squash) 3, 7 (bean) 5 (broccoli, cauliflower, strawberry) 7 (cabbage, collards, cranberry, cucumber, kale, kohlrabi) 10 (apricot, carrot, cherry, lettuce, melon, onion, parsley, parsnip, radish) 14 (apple, beet, Brussels sprouts, hopss, pear, rutabaga, spinach, Swiss chard, turnip) 16 (grape) 20 (peach)

Site	Application Method	Application Rate[1] (g a.i.)	Maximum # Applications/ year[2]	Minimum Period Between Applications	Pre-harvest Interval (days)
Food crops broccoli, Brussels sprouts, cabbage, cauliflower, carrot, corn, onion, parsnip, radish, rutabaga, tomato	Ground application: granular	1035–2750/ha	1 (corn carrot, broccoli, Brussels sprouts, cabbage, cauliflower, onion, parsnip, radish) 2 (rutabaga) *(1) rutabaga* Reapply as necessary (tomato)	Not applicable (corn, carrot, cole crops, onion, parsnip, radish) Variable: two weeks after thinning (rutabaga) 7 (tomato)	Not applicable 0 (tomato)
Christmas tree plantations	Ground application: mist blower	850/ha	Reapply as necessary *(1)*	Reapply as necessary	Not applicable
Ornamentals (outdoor non-residential) aralia, arborvitae, azalea, birch, boxwood, carnation, chrysanthemum, Euonymous, holly, ivy juniper, oak, pine, rose, taxus	Ground application: hydraulic sprayer	483–1875/1000 L	Reapply as necessary *(1) arborvitae, birch, boxwood, Euonymous, oak, taxus* *(2) juniper, pine* *(4) aralia, azalea, carnation, chrysanthemum, holly, ivy, rose*	Reapply as necessary	Not applicable

1 The rates in this table represent the range of rates for the specific pests registered on each site.

2 Numbers in italics are proposed by the registrants.

Appendix IIb Registered Commercial Class Uses of Diazinon Supported by the Technical Registrants as of December 2006

Site	Application Method	Application Rate[1] (g a.i.)	Maximum # Applications/year	Minimum Period Between Applications	Pre-harvest Interval (days)
Greenhouse food crops pepper, tomato	backpack sprayer	288/ha (peppers) 550–1000/ha (tomato)	Reapply as necessary	30 days or as needed (pepper) 7 days (tomato)	5 (pepper) 8 (tomato)
Seed treatment onion, radish, sugarbeet, potato seed pieces	seed treatment equipment (dry and slurry)	31.25/100 kg seed (sugar beet) 62.5/kg seed (onion, radish) 1/100 kg (potato seed pieces)	1	Not applicable	Not applicable
Feed crops clover, grass, green forage and hay from crop margins, pastures, rangeland	Ground application: hydraulic sprayer	500–550/ha 3500/ha[2]	Not stated Consult British Columbia spray calendar[2]	30 days Consult British Columbia spray calendar[2]	0 (green forage) 21 (hay) 14 (grass, clover)[2]
Food crops pepper (field), plum, prune, potato, salsify, tobacco (field)	Ground application: hydraulic sprayer	250–1675/ha	Reapply as necessary	Reapply as necessary	5 (pepper) 10 (plum, prune, salsify) 14 (potato) Not stated (tobacco)
Non-crop areas wastelands, roadsides, ditch banks, fencerows, barrier strips	Ground application: hydraulic sprayer	500-550/ha	Not stated	30 days	0 (green forage) 21 (hay)

[1] The rates in this table represent the range of rates for the specific pests registered on each site.

[2] For the control of leatherjackets in British Columbia only.

Appendix III Summary of crop-pest combinations for which the stakeholders provided comments on the value of diazinon, in addition to those identified in REV2005-06. Registered alternatives as of December 2006 are provided

Crop[1]	Pest[1]	Registered Alternatives to Diazinon[2] (Resistance Mode of Action (MoA) group[3])	Comments
apple	woolly apple aphid	(1A): carbaryl, methomyl, pirimicarb (eastern Canada only) (1B): malathion, phosalone, phosmet (2A): endosulfan (3): cyhalothrin-lambda, deltamethrin (4): acetamiprid Other: insecticidal soap[4], insecticidal soap[4]/pyrethrin	Concerns regarding the registered alternative active ingredients to diazinon for control of insect pests on apples include: ‣ spectrum of pest control for the registered alternatives and the potential need for an increased number of insecticide applications to maintain control of insect pests; ‣ secondary pest outbreaks; ‣ limitations of the registered alternatives e.g.: carbaryl, methomyl, malathion, phosalone, phosmet and endosulfan are currently under re-evaluation; as published in REV2006-01, use of pirimicarb (Pirimor, Reg. No. 22792) on apples is to expire by December 31, 2009.
beet	aphids	(1B): malathion, dimethoate (beet greens) Other: insecticidal soap[4], insecticidal soap[4], pyrethrin	Malathion and dimethoate are currently under re-evaluation.
blackberry	leafhoppers	(1A): carbaryl (1B): malathion, azinphos-methyl[5]	The registered alternative active ingredients to diazinon are currently under re-evaluation or are proposed for phase out.
broccoli	aphids	(1B): dimethoate, malathion, methamidophos, naled (2A): endosulfan (4): acetamiprid Other: insecticidal soap[4], insecticidal soap[4]/pyrethrin	Carbaryl, dimethoate, endosulfan, malathion, methamidophos, methomyl and *Bacillus thuringiensis* var *kurstaki* are currently under re-evaluation.
	diamondback moth	(1A): carbaryl, methomyl (1B): methamidophos, naled (2A): endosulfan (3): cyhalothrin-lambda, cypermethrin, deltamethrin, permethrin (5): spinosad (11): *Bacillus thuringiensis* var *kurstaki*	

Crop[1]	Pest[1]	Registered Alternatives to Diazinon[2] (Resistance Mode of Action (MoA) group[3])	Comments
	imported cabbageworm	(1A): carbaryl, methomyl (1B): malathion, methamidophos, naled (2A): endosulfan (3): cyhalothrin-lambda, cypermethrin, deltamethrin, permethrin (5): spinosad (11): *Bacillus thuringiensis* var *kurstaki*	
Brussels sprouts	aphids	(1B): acephate (green peach aphid), dimethoate, malathion, methamidophos, naled (2A): endosulfan (4): acetamiprid, imidacloprid (green peach and cabbage aphid) Other: insecticidal soap[4], insecticidal soap[4]/pyrethrin	Acephate, carbaryl, diazinon, dimethoate, malathion, methamidophos, methomyl, trichlorfon and *Bacillus thuringiensis* var *kurstaki* are currently under re-evaluation.
	diamondback moth	(1A): carbaryl, methomyl (1B): acephate, methamidophos, naled, trichlorfon (2A): endosulfan (3): cyhalothrin-lambda, cypermethrin, deltamethrin, permethrin (5): spinosad (11): *Bacillus thuringiensis* var *kurstaki*	
	imported cabbageworm	(1A): carbaryl, methomyl (1B): acephate, malathion, methamidophos, naled, trichlorfon (2A): endosulfan (3): cyhalothrin-lambda, cypermethrin, deltamethrin, permethrin (5): spinosad (11): *Bacillus thuringiensis* var *kurstaki*	
cabbage	aphids	(1B): acephate (green peach aphid), malathion, methamidophos, naled (2A): endosulfan (4): acetamiprid Other: insecticidal soap[4], insecticidal soap[4]/pyrethrin	Acephate, carbaryl, endosulfan, malathion, methamidophos, methomyl, trichlorfon and *Bacillus thuringiensis* var *kurstaki* are currently under re-evaluation.

Crop[1]	Pest[1]	Registered Alternatives to Diazinon[2] (Resistance Mode of Action (MoA) group[3])	Comments
	diamondback moth	(1A): carbaryl, methomyl (1B): acephate, methamidophos, naled, trichlorfon (2A): endosulfan (3): cyhalothrin-lambda, cypermethrin, deltamethrin, permethrin (5): spinosad (11): *Bacillus thuringiensis* var *kurstaki*	
	imported cabbageworm	(1A): carbaryl, methomyl (1B): acephate, malathion, methamidophos, naled[5], trichlorfon (2A): endosulfan (3): cyhalothrin-lambda, cypermethrin, deltamethrin, permethrin (5): spinosad (11): *Bacillus thuringiensis* var *kurstaki*	
carrot	aphids	(1A): malathion Other: insecticidal soap[4], insecticidal soap[4]/pyrethrin	Malathion is currently under re-evaluation.

Crop[1]	Pest[1]	Registered Alternatives to Diazinon[2] (Resistance Mode of Action (MoA) group[3])	Comments
cauliflower	aphids	(1B): acephate (green peach aphid), dimethoate, malathion, methamidophos, naled (2A): endosulfan (4): acetamiprid Other: insecticidal soap[4], insecticidal soap[4]/pyrethrin	Acephate, carbaryl, endosulfan, dimethoate, malathion, methamidophos, methomyl, trichlorfon and *Bacillus thuringiensis* var *kurstaki* are currently under re-evaluation.
	diamondback moth	(1A): carbaryl, methomyl (1B): acephate, methamidophos, naled, trichlorfon (2A): endosulfan (3): cyhalothrin-lambda, cypermethrin, deltamethrin, permethrin (5): spinosad (11): *Bacillus thuringiensis* var *kurstaki*	
	imported cabbageworm	(1A): carbaryl, methomyl (1B): acephate, malathion, methamidophos, naled, trichlorfon (2A): endosulfan (3): cyhalothrin-lambda, cypermethrin, deltamethrin, permethrin (5): spinosad (11): *Bacillus thuringiensis* var *kurstaki*	
cranberry	cranberry fruitworm	(1A): carbaryl (1B): azinphos-methyl[5], malathion	With the exception of tebufenozide and a pheromone, the registered alternative active ingredients are currently under re-evaluation or are proposed for phase out. As azinphos-methyl is proposed to be phased out for use on cranberry, diazinon is the only registered active ingredient for rotation with tebufenozide for the purposes of delaying the development of resistance for the control of Sparganothis fruitworm.
	blackheaded fireworm	(1A): carbaryl (1B): acephate, azinphos-methyl[5], malathion, phosmet (18): tebufenozide Other: pheromone	
	Sparganothis fruitworm	(1B): azinphos-methyl[5] (18): tebufenozide	
currant, gooseberry	aphids	(1B): malathion	Malathion is currently under re-evaluation.
	lecanium scale	None	No registered alternatives.
	sawflies		

Crop[1]	Pest[1]	Registered Alternatives to Diazinon[2] (Resistance Mode of Action (MoA) group[3])	Comments
kale	aphids	(1B): dimethoate, malathion, naled (4): acetamiprid Other: insecticidal soap[4], insecticidal soap[4]/pyrethrin	Carbaryl, dimethoate, malathion and *Bacillus thuringiensis* are currently under re-evaluation.
	diamondback moth	(1A): carbaryl (1B): naled (3): deltamethrin (eastern Canada and British Columbia) (5): spinosad (11): *Bacillus thuringiensis* var *kurstaki*	
	imported cabbageworm	(1A): carbaryl (1B): malathion, naled (3): deltamethrin (eastern Canada and British Columbia) (5): spinosad (11): *Bacillus thuringiensis* var *kurstaki*	
kohlrabi	aphids	(1B): malathion (4): acetamiprid Other: insecticidal soap[4], insecticidal soap[4]/pyrethrin	Malathion is currently under re-evaluation.
	diamondback moth	(1A): carbaryl (5): spinosad	Carbaryl is currently under re-evaluation.
	imported cabbageworm	(1A): carbaryl (1B): malathion (5): spinosad	Carbaryl and malathion are currently under re-evaluation.
lettuce	dipterous leafminers	(1B): trichlorfon (17): cyromazine (pea leafminer)	Trichlorfon is currently under re-evaluation. Cyromazine is limited to control of pea leafminer only (a dipterous leafminer)

Crop[1]	Pest[1]	Registered Alternatives to Diazinon[2] (Resistance Mode of Action (MoA) group[3])	Comments
onion[6]	onion maggot	(1A): chlorpyrifos (1B): naled (adult flies) (3): cypermethrin (adult flies) (17): cyromazine	One spray of diazinon will also control thrips (a secondary target pest) and is believed to provide protection from leek moth (a newly introduced pest). Diazinon is registered to control adults and larvae. Naled and cypermethrin will control adult flies only. Chlorpyrifos is registered as a granular formulation, applied in furrow to control larvae. Chlorpyrifos is currently under re-evaluation. Cyromazine is registered for use on imported treated onion seeds for planting in muck soils in eastern Canada only. Fields planted with cyromazine treated seeds may only be rotated to specific crops.
	thrips	(1A): malathion (1B): naled (3): cypermethrin, cyhalothrin-lambda, deltamethrin (eastern Canada and British Columbia only)	Malathion is currently under re-evaluation.
parsley	diamondback moth	(1A): carbaryl (5): spinosad (11): *Bacillus thuringiensis* var *kurstaki*	Diamondback moth and imported cabbageworm are sporadic pests of parsley. Carbaryl and *Bacillus thuringiensis* var *kurstaki* are currently under re-evaluation.
	imported cabbage worm	(1A): carbaryl (5): spinosad (11): *Bacillus thuringiensis* var *kurstaki*	
parsnip	aphids	(1A): malathion Other: insecticidal soap[4], insecticidal soap[4]/pyrethrin	Few or no registered alternative active ingredients. Malathion and carbaryl are currently under re-evaluation.
	dipterous leafminers	None	
	flea beetle	(1A): carbaryl	

Crop[1]	Pest[1]	Registered Alternatives to Diazinon[2] (Resistance Mode of Action (MoA) group[3])	Comments
pepper[7]	aphids	(1A): pirimicarb (green peach aphid) (1B): acephate (green peach aphid on bell peppers), dimethoate, malathion (2A): endosulfan Other: insecticidal soap[4], insecticidal soap[4]/pyrethrin	Acephate, dimethoate, malathion and endosulfan are currently under re-evaluation. As published in REV2006-01, use of pirimicarb (Pirimor, Reg. No. 22792) on pepper is to expire by December 31, 2009.
radish	dipterous leafminers	None	No registered alternative active ingredients.
	flea beetles	(1A): carbaryl (1B): malathion (3): permethrin (crucifer flea beetle)	Carbaryl and malathion are currently under re-evaluation. Permethrin is registered to control crucifer flea beetle only.
raspberry	aphids	(1A): carbaryl (raspberry aphid) Other: insecticidal soap[4], insecticidal soap[4]/pyrethrin	Few registered alternative active ingredients. Carbaryl and malathion are currently under re-evaluation. Azinphos-methyl use on raspberries is proposed to be phased out.
	leafhoppers	(1A): carbaryl (1B): azinphos-methyl[5], malathion	
	thrips	(1B): malathion	
rutabaga, turnip	aphids	(1B): malathion, dimethoate (turnip greens only) (2A): endosulfan Other: insecticidal soap[4], insecticidal soap[4]/pyrethrin, mineral oil (rutabaga only)	Few alternative active ingredients are registered to control this pest. Malathion, dimethoate and endosulfan are currently under re-evaluation. Dimethoate is registered for turnip greens only.
	dipterous leafminers	(1B): trichlorfon	Trichlorfon is currently under re-evaluation.
	adult root maggots	(1B): chlorpyrifos (cabbage maggot on rutabaga) None (turnip)	No registered alternative active ingredients to control root maggots on turnips. Only chlorpyrifos is registered to control cabbage maggots on rutabaga. Chlorpyrifos is currently under re-evaluation. Carbofuran was registered as an emergency use to control root maggot on rutabaga and turnips in 2006.
	flea beetles	(1A) carbaryl (2A): endosulfan (3): cypermethrin (crucifer flea beetle), permethrin (crucifer flea beetle on turnips)	Carbaryl and endosulfan are currently under re-evaluation.

Crop[1]	Pest[1]	Registered Alternatives to Diazinon[2] (Resistance Mode of Action (MoA) group[3])	Comments
tobacco (greenhouse grown seedlings)	ants	None	No registered alternative active ingredients to diazinon.
tomato	aphids	(1A): methomyl (1B): acephate, dimethoate, malathion (2A): endosulfan (4): acetamiprid Other: insecticidal soap[4], insecticidal soap[4]/pyrethrin	With the exception of acetamiprid and insecticidal soap, the registered alternative active ingredients to diazinon are currently under re-evaluation.

1 Comments were received for the listed site-pest combinations in response to REV2005-06. Crops and pests listed are in addition to those identified as "key" in REV2005-06.

2 This is a list of registered alternatives only (as of 19 December 2006). The PMRA does not endorse any of the alternatives listed. A number of the listed alternative active ingredients are in the process of being re-evaluated by the PMRA, including the following active ingredients for which proposal and information update documents have been published: acephate, *Bacillus thuringiensis*, carbaryl, chlorpyrifos, endosulfan, malathion, phosalone and phosmet. The registration status of active ingredients under re-evaluation may change pending the final regulatory decision. The re-evaluation of the following active ingredients are complete: insecticidal soap (RRD2004-26) and naled (RRD2006-24). For additional information, consult the *Re-evaluation Summary Table* on the PMRA publications Re-evaluation website: (English) www.pmra-arla.gc.ca/english/pubs/reeval-e.html or (French) www.pmra-arla.gc.ca/francais/pubs/reeval-f.html.

3 Resistance Management Group Numbers for insecticides: 1A = acetylcholinesterase inhibitors (carbamates); 1B = acetylcholinesterase inhibitors (organophosphates); 2A = gamma-aminobutyric acid (GABA) gated chloride channel antagonists; 3 = sodium channel modulators; 4 = acetylcholine receptor agonists/antagonists; 5 = acetylcholine receptor modulators; 11 = microbial disruptors of insect mid-gut membranes; 17 = inhibition of chitin biosynthesis; 18 = ecdysone agonist.

4 Due to short residual activity and potential for phytotoxicity from repeated applications, insecticidal soap is not considered to be a viable alternative to diazinon.

5 The re-evaluation of azinphos-methyl is complete. The use of azinphos-methyl is proposed to be phased out as outlined in REV2006-04.

6 Application of diazinon as a seed treatment to onion is not supported by the registrants. Foliar spray applications to control onion maggot flies (adults) are supported by the registrants. Granular formulations (in furrow) and drenches (in furrow) to control onion maggot larvae are supported by the registrants.

7 The use of diazinon on field grown peppers is not supported by the technical registrants.

Appendix IV Proposed diazinon phase out criteria by use site and application method based upon value considerations and availability of registered alternative active ingredients

Use Site Category (USC)	Application Method	Proposed Phase Out[1]	Crop/site
USC 4 forest and woodlots	air blast	longer term	Christmas tree plantations
USC 5 greenhouse food	foliar spray	short term	pepper,[2] tomato[2] mushroom houses[3]
		longer term	tobacco (seedlings)
USC 8 livestock for food	ear tag	no phase out	cattle
USC 10 seed treatment	seed treatment	short term	bean (dry), bean (succulent, green), corn (sweet), onion[2], pea (dry)[3], pea (succulent, green), potato[2] radish[2], soybean, sugar beet[2],
USC 13 feed crops	foliar spray	short term	clover[2], green forage/hay[2], grass[2], pastures[2], rangeland[2]
USC 14 terrestrial food crops	soil drench	no phase out	blackberry, broccoli, Brussels sprouts, cabbage, cauliflower, loganberry, onion, raspberry, rutabaga, turnip

Use Site Category (USC)	Application Method	Proposed Phase Out[1]	Crop/site
USC 14 terrestrial food crops	foliar spray	short term	apricot[2], bean (dry, field)[3], bean (green, succulent)[3], beet, broccoli, Brussels sprouts, cabbage, cauliflower, collards[3], cucumber[3], grape[3], hops[3], kale, kohlrabi, lettuce, melon[3], radish, parsley, peach[3], pear[3], pepper[2], plum[2], potato[2], prune[2], salsify[2], spinach, squash[3], Swiss chard[3], tobacco[2], tomato
		longer term	apple, blackberry, carrot, cherry, cranberry, currant, gooseberry, loganberry, onion, parsnip, raspberry, rutabaga, strawberry, turnip
	granular	short term	broccoli[3], Brussels sprouts[3], cabbage[3], cauliflower[3], corn[3], rutabaga tomato[3] (broadcast application)

Use Site Category (USC)	Application Method	Proposed Phase Out[1]	Crop/site
		longer term	carrot, onion, parsnip, radish, turnip
USC 16 non-crop areas	foliar spray	short term	barrier strips[2], ditch banks[2], fence rows[2], roadsides[2], wastelands[2]
USC 27 Outdoor ornamentals[3]	foliar spray	short term	aralia, arborvitae, azalea, birch, boxwood, carnation, chrysanthemum, Euonymous, holly, ivy, juniper, oak, pine, rose, taxus

1 Proposed phase out criteria are as follows:
Short term phase out is proposed for uses which are not supported by the registrant, or for uses supported by the registrants for which registered alternatives are currently available and:

- were not identified as "Key" in REV2005-06; or
- where no comments were received in response to the consultation for REV2005-06; or
- where comments were received indicating the loss of diazinon would result in little impact.

Longer term phase out is proposed for crops where the use of diazinon has value (e.g. identified as "key uses" in REV2005-06 or based on comments received in response to REV2005-06) and/or where there are no registered alternative active ingredients. During phase out period and for any on-going uses, additional PPE, implementation of closed mix/loading systems would help mitigate worker risk. Post-application risk will be addressed by restricted entry intervals.

2 Use is not supported by the technical registrants

3 The use was not identified as a "key use" in REV2005-06, *Preliminary risk and value assessment of diazinon* and no comments were received from consultation with the public.